

HEALTH ASPECTS OF INDOOR AIR POLLUTION: SOCIAL, LEGISLATIVE, AND ECONOMIC CONSIDERATIONS*

EDWARD F. FERRAND, Ph.D., AND STACEY MORIATES, DR. P.H.

Bureau of Science and Technology
New York City Department of Environmental Protection
New York, New York

The indoor air environment has affected health adversely since fire was discovered and its combustion products entered cave dwellings. Human inventiveness, the same phenomenon that brought fire inside for cooking and heating, has also devised such activities as tobacco smoking and the use of aerosols. Of late, our ingenuity in finding ways to conserve energy has trapped air contaminants generated indoors within buildings and significantly increased our dose of both the new and ancient enemies of our respiratory systems.

Concern about indoor air pollution has fluctuated over the years, depending upon the state of public and government awareness of possible adverse affects on health. A major reason for neglect of indoor air pollution in residences and public places has been the much stronger focus on outdoor and workplace environments. Although some investigations have been made into the impact of outdoor air pollution on indoor spaces, little attention has been given to the relatively few studies addressing this problem, largely because of the presumption that pollution indoors was at worst the same as that outdoors, and probably significantly less.

In 1965 our laboratory published a short study motivated by concern about apartment houses immediately adjacent to or above motor vehicle expressways. Our results showed that levels of hydrocarbons, nitrogen dioxide, and suspended particulate matter could be significantly higher inside such apartments than those measured at an outdoor monitoring station located in an area noted for high pollution levels.¹ A much more

* Presented as part of a *Symposium on Health Aspects of Indoor Air Pollution* held by the Committee on Public Health of the New York Academy of Medicine held at the Academy May 28 and 29, 1981.

detailed study, performed in 1972 by the General Electric Corp. in New York City, demonstrated a close relationship between indoor-outdoor levels of carbon monoxide.² In the same year Benson et al., in a literature review of indoor-outdoor studies for the U.S. Environmental Protection Agency, reported that factors relating to house construction and home activities could predominate over outside sources in determining indoor pollution levels.³ We were surprised in 1970 to find that bridge and tunnel toll collectors were exposed to much higher air pollutant concentrations inside the toll booths than in the surrounding outdoors or even inside the tunnel.⁴

A provocative study by Giersteker and DeGraaf in Rotterdam concluded that apparent correlations between mortality and outdoor sulfur dioxide concentrations could instead be explained by the backflow of chimney gases on days with low wind speeds. They proposed that excess mortality in the Netherlands on such days could be attributed to indoor exposures to carbon monoxide.⁵

Well-established social customs such as cigarette smoking are difficult to affect. However, it is clear that cigarette smoke, both directly and in synergism with other air contaminants, is of singular importance in its effect on the indoor environment. Traditionally, nonsmokers have accepted, although with increasing reluctance, exposures which, coming from a different source, would result in a public outcry for regulation or even outright prohibition.

Similarly, our societal habits of using chemicals to clean and to perfume ourselves and our surroundings have led us to accept exposures to a great variety of substances with uncertain consequences to health.

The fact of this conference, increasing media attention to the problem and growth of antismoking citizen activity clearly indicate growing awareness and concern by the public. And this rapidly growing concern that a wide range of unpleasant symptoms may be attributable to the air we breathe indoors has found those of us with governmental responsibility unprepared to respond satisfactorily. We lack sufficient knowledge, investigative techniques, equipment, and trained personnel to cope with the kinds and number of problems that present themselves daily.

In the period between November 1980 and May 1981 we received 98 complaints from both residential and workplace sources. Nongovernmental workplace complaints are referred to the Occupational Safety and Health Agency unless we are invited to investigate the problem by management. The 98 complaints can be broken down according to the

following types: symptoms of unknown origin, 32; symptoms caused by poor ventilation, 13; indoor problems caused by outdoor sources, 11; and a specific chemical product believed to have caused symptoms, or feared for its potential harm, 42.

These cases came from a variety of sources, often reaching us after the complainant had previously contacted a number of different agencies. Our activities in this area have not been publicized; therefore we tend to be reached by the more enterprising members of the community. We suspect that any publicity given to the program would result in a substantial increase in demand for our services. The jurisdiction of government agencies in the investigation and control of indoor air environments is not at all clear, especially on the national scale.

Although several agencies have been involved through existing laws and their broad enabling powers, there is presently no legislation that directly authorizes any federal agency to regulate indoor air pollution. According to the report of the National Commission on Air Quality, both the Environmental Protection Agency and the General Accounting Office agree that the Agency does not have specific authority to regulate indoor air quality.⁶

The U.S. Department of Housing and Urban Development has been concerned about the indoor air environment in its assisted housing projects. Recognizing the lack of standards applicable to indoor environments, it initiated a program with the objective that "design guidance be provided which will promote healthful, desirable environments."⁷ As part of this program, it supported a survey of indoor air quality standards⁷ and a study of indoor air pollution.⁸

A study by the General Accounting Office concluded that the inevitable result of no single agency with authority over nonworkplace air quality is a fragmented and incomplete approach to indoor air pollution. The General Accounting Office, in this report, recommended that congress amend the Clean Air Act to provide the Environmental Protection Agency with the authority and responsibility for indoor air quality in the nonworkplace.⁹ However, the National Commission on Air Quality did not recommend that any agency have authority over air pollution. Instead, it recommended that Congress address the issue and direct "appropriate federal agencies to undertake a systematic and coordinated program to develop more explicit information on the source strengths of major pollutants" and require one agency to report to Congress within two years on "appropriate approaches to assuring healthful air quality in

federal buildings throughout the United States including office buildings and hospitals.”⁶

The fragmented approach of the federal government can be demonstrated by citing a few examples. The Environmental Protection Agency has used the Toxic Substances Control Act to go after asbestos, formaldehyde, and lead paint. The Pesticide Act grants the Agency complete control over the manufacture, distribution, packaging, and use of pesticides even in one's own home. The Agency has used the Safe Drinking Water Act to check radon which can be released to the indoor environment from tap water. A related Agency concern is water contaminated by asbestos. Under the Uranium Mine Tailings Act, the Agency would prevent another Grand Junction incident wherein radiation from land filled with mine tailings adversely affected residents living in homes constructed on the site. The Department of Energy through the National Energy Act which created the Residential Energy Conservation Service is authorized to “set minimum standards for general safety and effectiveness.” The Department of Housing and Urban Development is mandated by the Housing Act of 1949 to provide “decent home and suitable living environment (or quality living environment).” A notice of proposed rule making, which appeared in the *Federal Register*, July 25, 1980, stated that the Department will develop indoor air standards for new construction. The Occupational Safety and Health Act of 1970 directs that Agency “to assure safe and healthful working conditions for working men and women” but government employees are excluded. The Consumer Product Safety Commission's enabling legislation, the Consumer Product Safety Act of 1972, gives the agency control over the safety of consumer products which contribute to indoor pollution.

An interagency committee co-chaired by the Environmental Protection Agency and the Department of Energy will study the causes of indoor air pollution and possible controls.

In addition, the American Society for Heating, Refrigeration and Air-Conditioning Engineers has revised their standards, *Ventilation for Acceptable Indoor Air Quality*. The standards incorporate two procedures: a ventilation rate procedure which is prescriptive and an indoor air quality procedure that takes into account equipment performance, best known control technology, and concentrations of indoor air pollutants, exclusive of processing within industrial buildings.

On the state level there is a draft bill in the Assembly Health Committee to amend the public health law to establish a center for indoor air

studies within the Department of Health to investigate the causes, levels, and impacts of indoor air pollution. At this point a small group in Albany within the Health Department is charged with indoor air quality responsibilities.

Also in New York State, effective December 25, 1980, the Public Employees Safety Health Act grants the Industrial Commissioner in the Department of Labor exclusive authority to enforce safety and health standards promulgated under this act. Locally, the City Health Department and the Department of Environmental Protection are the agencies with the major involvement in the control of indoor air pollution. In addition, the Fire Department performs or audits inspections of hospitals and schools as authorized by Chapter 19 (fire prevention) and Chapter 26 (buildings) of the Administrative Code. A recent addition has been the establishment in the Department of Personnel of a citywide Occupational Safety and Health Program that concerns itself, among other things, with the indoor working environment of city employees.

The nature and magnitude of the indoor air pollution problem is not well understood. Therefore, the economic burdens imposed upon society in terms of increased health care, lost work time, and lost production cannot be determined until we know much more than we do at present.

Important questions that must be answered are: What are the nature, source, and concentration ranges of the significant contaminants of the indoor environment? What exposures and doses do the public experience? How do we measure these? What morbidity and mortality is caused? How do we measure these? What control technology is available now and in the foreseeable future? How effective and how costly is it?

Some of our past efforts to provide supportive data for environmental control programs have met with little success because sufficient resources were not allocated at an early stage. In fact, the costs of the programs and the investment made in the supporting data bases have often been grossly out of proportion. A suggested outline for a program to control indoor air pollution on a national scale might include the following: identification and quantification of the indoor air pollution problem, including nature of the pollutants and their sources, time and activity dependencies of concentrations, exposure and dose relationships, and dose and adverse health effects relationships; development of health-based standards; evaluation of available and potential control technology and its costs; and establishment of goals and development of implementation plans and methods to ensure progress.

A distinction must be made between standards and goals. Standards should correspond to exposures above which adverse health effects are produced in the most susceptible group that represents a significant number of individuals. Control programs should be goal-oriented and attempt to schedule step-by-step goals attainable by technologically and economically available controls.

It is important that we establish both standards and goals with the intent of developing a carefully designed, realistic program to achieve goals at a prescribed rate with the standard as the ultimate objective.

The federal government has the duty to take a leadership role in defining the problem of indoor air pollution. Hitherto, expensive regulatory programs have, on occasion, been based on insufficiently understood problems. The unfortunate result has been gross economic waste. We must beware of this pitfall. As public pressure mounts, improperly designed responses will be forthcoming without clear understanding of the nature and extent of the problem and established priorities. Federal leadership is required lest we misdirect our efforts in an attempt to respond to growing public demand.

REFERENCES

1. Braverman, M. M. and Smith, C.: A study of the effect of motor vehicle exhaust on the breathing air of apartment houses. *J. Am. Ind. Hyg. Assoc.* 26:84-85, 1965.
2. General Electric Company: *Indoor-Outdoor Carbon Monoxide Pollution Study*. EPA-R4-73-20. Philadelphia, General Electric Company, 1972.
3. Benson, F. B., Henderson, J. J., and Caldwell, D. E.: *Indoor-Outdoor Air Pollution Relationships: A Literature Review*. Pub. AP-112. Research Triangle Park, N. C., U.S. Environmental Protection Agency, 1972.
4. Scott Research Laboratories, Inc.: *A Study of Air Pollutants at Various Locations at the Facilities of the Triborough Bridge and Tunnel Authority. TBTA Randall's Island, N.Y.* Plumsteadville, Pa., Scott Research Laboratories, Inc., 1971.
5. Biersteker, K. and DeGraaf, H.: Air pollution indoors. A neglected variable in epidemiology? *Mag. Soc. Med.* 45 (3): 74-77, 1967.
6. National Commission on Air Quality: *To Breathe Clean Air*. Washington, D. C., 1981.
7. McFadden, J. E., Beard, J. H. III, and Moschandreas, D. J.: *Survey of Indoor Air Quality Health Criteria and Standards*. EPA-600/7-78-027. Gaithersburg, Md., GEOMET, Inc., 1978.
8. GEOMET, Inc.: *Indoor Air Pollution in the Residential Environment*, vol II: *Field Monitoring Protocol, Indoor Episodic Pollutant Release Experiments and Numerical Analyses*. Moschandreas, D. J., editor. EPA-600/7-78-229b. Gaithersburg, Md., GEOMET, Inc. 1978.
9. U. S. General Accounting Office: *Indoor Air Pollution: An Emerging Health Problem*. Report to Congress by the Comptroller General CED-80-111. Washington, D. C., 1980.